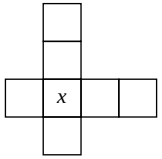
18. The numbers 2, 3, 4, 5, 6, 7, 8 are to be placed, one per square, in the diagram shown such that the four numbers in the horizontal row add up to 21 and the four numbers in the vertical column also add up to 21.
Which number should replace $x$ ?




A 2 B 3 C 5 D 7 E 8

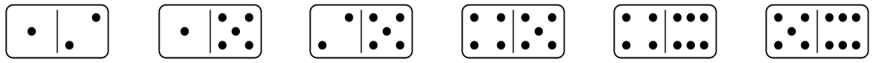
19. In rectangle $PQRS$, the ratio of $\angle PSQ$ to $\angle PQS$ is 1:5. What is the size of $\angle QSR$?

A 15° B 18° C 45° D 72° E 75°

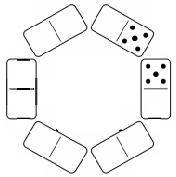
20. Aroon says his age is 50 years, 50 months, 50 weeks and 50 days old. What age will he be on his next birthday?

A 56 B 55 C 54 D 53 E 51

21.

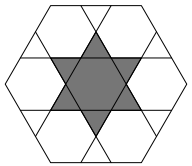


Dominic wants to place the six dominoes above in a hexagonal ring so that, for every pair of adjacent dominoes, the numbers of pips match. The ring on the right indicates how one adjacent pair match.
In a completed ring, how many of the other five dominoes can he definitely *not* place adjacent to ?



A 1 B 2 C 3 D 4 E 5

22. The diagram shows a design formed by drawing six lines in a regular hexagon. The lines divide each edge of the hexagon into three equal parts.
What fraction of the hexagon is shaded?



A $\frac{1}{5}$ B $\frac{2}{9}$ C $\frac{1}{4}$ D $\frac{3}{10}$ E $\frac{5}{16}$

23. Peter wrote a list of all the numbers that could be produced by changing one digit of the number 200. How many of the numbers on Peter's list are prime?

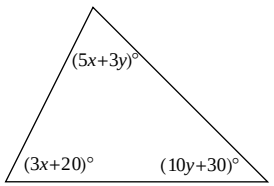
A 0 B 1 C 2 D 3 E 4

24. After playing 500 games, my success rate at Spider Solitaire is 49%. Assuming I win every game from now on, how many extra games do I need to play in order that my success rate increases to 50% ?

A 1 B 2 C 5 D 10 E 50

25. The interior angles of a triangle are $(5x + 3y)°$, $(3x + 20)°$ and $(10y + 30)°$ where $x$, $y$ are positive integers.
What is the value of $x + y$?

A 15 B 14 C 13 D 12 E 11




# UK JUNIOR MATHEMATICAL CHALLENGE

THURSDAY 26th APRIL 2012

Organised by the **United Kingdom Mathematics Trust from the School of Mathematics, University of Leeds**

The Actuarial Profession
making financial sense of the future

**RULES AND GUIDELINES** (to be read before starting)

1. Do not open the paper until the Invigilator tells you to do so.
2. Time allowed: **1 hour**.
   No answers, or personal details, may be entered after the allowed hour is over.
3. The use of rough paper is allowed; **calculators** and measuring instruments are **forbidden**.
4. Candidates in England and Wales must be in School Year 8 or below.
   Candidates in Scotland must be in S2 or below.
   Candidates in Northern Ireland must be in School Year 9 or below.
5. **Use B or HB pencil only**. Mark *at most one* of the options A, B, C, D, E on the Answer Sheet for each question. Do not mark more than one option.
6. *Do not expect to finish the whole paper in 1 hour*. Concentrate first on Questions 1-15. When you have checked your answers to these, have a go at some of the later questions.
7. Five marks are awarded for each correct answer to Questions 1-15.
   Six marks are awarded for each correct answer to Questions 16-25.
   **Each incorrect answer to Questions 16-20 loses 1 mark.**
   **Each incorrect answer to Questions 21-25 loses 2 marks.**
8. Your Answer Sheet will be read only by a *dumb machine*. **Do not write or doodle on the sheet except to mark your chosen options**. The machine 'sees' all black pencil markings even if they are in the wrong places. If you mark the sheet in the wrong place, or leave bits of rubber stuck to the page, the machine will 'see' a mark and interpret this mark in its own way.
9. The questions on this paper challenge you to **think**, not to guess. You get more marks, and more satisfaction, by doing one question carefully than by guessing lots of answers.
   The UK JMC is about solving interesting problems, not about lucky guessing.

**The UKMT is a registered charity**

*http://www.ukmt.org.uk*

1. What is the smallest four-digit positive integer which has four different digits?

A 1032 B 2012 C 1021 D 1234 E 1023

2. What is half of 1.01?

A 5.5 B 0.55 C 0.505 D 0.5005 E 0.055

3. Which of the following has exactly one factor other than 1 and itself?

A 6 B 8 C 13 D 19 E 25

4. Beatrix looks at the word JUNIOR in a mirror.
How many of the reflected letters never look the same as the original, no matter how Beatrix holds the mirror?

A 1 B 2 C 3 D 4 E 5

5. One of the mascots for the 2012 Olympic Games is called 'Wenlock' because the town of Wenlock in Shropshire first held the Wenlock Olympian Games in 1850. How many years ago was that?

A 62 B 152 C 158 D 162 E 172

6. The diagrams on the right show three different views of the same cube. Which letter is on the face opposite U?

A I B P C K D M E O

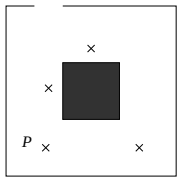
7. A small ink cartridge has enough ink to print 600 pages. Three small cartridges can print as many pages as two medium cartridges. Three medium cartridges can print as many pages as two large cartridges. How many pages can be printed using a large cartridge?

A 1200 B 1350 C 1800 D 2400 E 5400

8. Tommy Thomas's tankard holds 480ml when it is one quarter empty. How much does it hold when it is one quarter full?

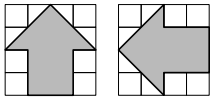
A 120 ml B 160 ml C 240 ml D 960 ml E 1440 ml

9. The diagram on the right shows the positions of four people (each marked ×) in an Art Gallery. In the middle of the room is a stone column. Ali can see none of the other three people. Bea can see only Caz. Caz can see Bea and Dan. Dan can see only Caz.
Who is at position *P*?




A Ali B Bea C Caz
D Dan E More information needed

10. The diagram shows two arrows drawn on separate 4 cm × 4 cm grids. One arrow points North and the other points West.
When the two arrows are drawn on the same 4 cm × 4 cm grid (still pointing North and West) they overlap. What is the area of overlap?



A 4 cm² B 4½ cm² C 5 cm² D 5½ cm² E 6 cm²

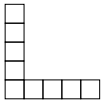
11. In the following expression, each □ is to be replaced with either + or – in such a way that the result of the calculation is 100.

123 □ 45 □ 67 □ 89

The number of + signs used is *p* and the number of – signs used is *m*. What is the value of *p* – *m*?

A –3 B –1 C 0 D 1 E 3

12. Laura wishes to cut this shape, which is made up of nine small squares, into pieces that she can then rearrange to make a 3 × 3 square.
What is the smallest number of pieces that she needs to cut the shape into so that she can do this?



A 2 B 3 C 4 D 5 E 6

13. In the multiplication grid on the right, the input factors (in the first row and the first column) are all missing and only some of the products within the table have been given.
What is the value of A + B + C + D + E?

| × | | | | | |
|---|---|---|---|---|---|
| | A | 10 | | 20 | |
| | 15 | B | 40 | | |
| | 18 | | C | 60 | |
| | | 20 | | D | 24 |
| | | | 56 | | E |

A 132 B 145 C 161 D 178 E 193

14. A pattern that repeats every six symbols starts as shown below:

♥ ♣ ♥ ♦ ♥ ♠ ♥ ♣ ♥ ♦ ♥ ♠ …

Which are the 100th and 101st symbols, in that order, in the pattern?

A ♦ ♥ B ♥ ♦ C ♥ ♣ D ♠ ♥ E ♣ ♥

15. Talulah plants 60 tulip bulbs. When they flower, she notes that half are yellow; one third of those which are not yellow are red; and one quarter of those which are neither yellow nor red are pink. The remainder are white. What fraction of the tulips are white?

A $\frac{1}{24}$ B $\frac{1}{12}$ C $\frac{1}{6}$ D $\frac{1}{5}$ E $\frac{1}{4}$

16. Beth, Carolyn and George love reading their favourite bedtime story together. They take it in turns to read a page, always in the order Beth, then Carolyn, then George. All twenty pages of the story are read on each occasion. One evening, Beth is staying at Grandma's house but Carolyn and George still read the same bedtime story and take it in turns to read a page with Carolyn reading the first page.
In total, how many pages are read by the person who usually reads that page?

A 1 B 2 C 4 D 6 E 7

17. There are six more girls than boys in Miss Spelling's class of 24 pupils. What is the ratio of girls to boys in this class?

A 5:3 B 4:1 C 3:1 D 1:4 E 3:5